Cost Comparison Between

Sacrificial Metal
Wafer Level Burn-in and Test (SM WLBT)
vs.
Package Burn-In and Test

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Agenda / Outline

Burn-In Overview

Primary Attribute Differences

Package Burn-In Cost Attributes

Package Cost Analysis Equations

SM WLBT Cost Attributes

SM WLBT Cost Analysis Equations

SM WLBT Forecast vs. Actual Cost

Summary

KGD Sacrificial Metal WLBT
- Definitions -

- **Wafer Level Burn-In and Test (WLBT)**

  Parallel, dynamic, excitation of all devices on a wafer to screen marginal devices for infant mortality by dynamically stressing the integrated circuit at elevated temperature and voltage. Capable of non-volatile memory cycling, module exercising, and testing.

- **Known Good Die (KGD)**

  Die having the same quality and reliability level as that of an equivalent packaged part.

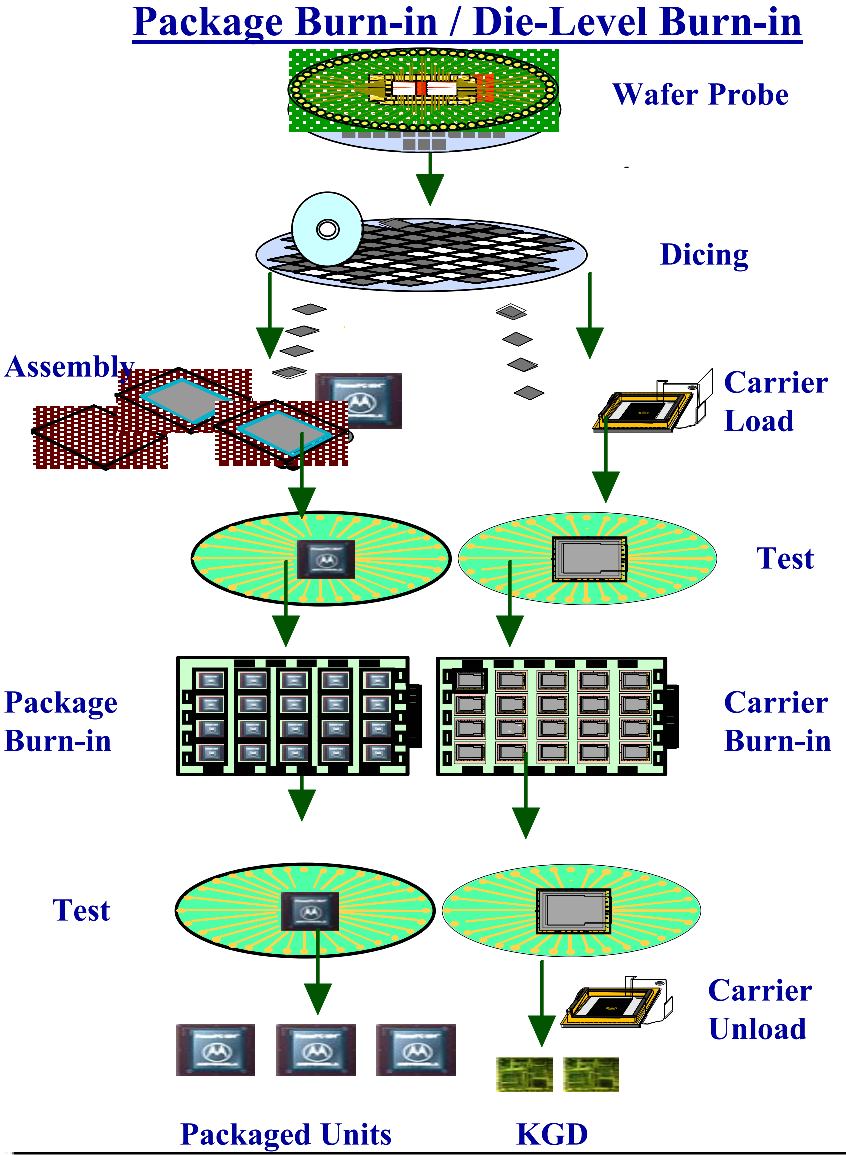
- **Sacrificial Metal (SM)**

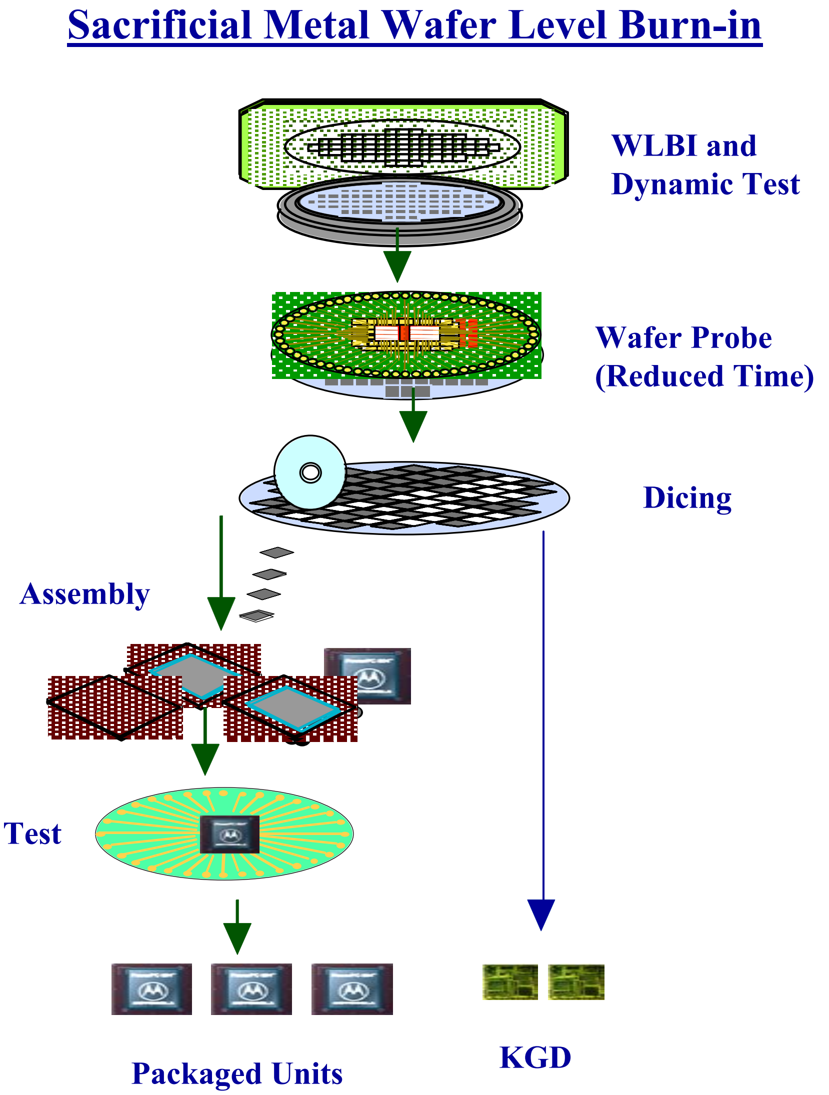
  Metal which is temporarily deposited on the wafer to provide electrical signal paths to a die during wafer level burn-in and test. The sacrificial metal is etched away after burn-in and test is complete.

Why WLBT?

- Smaller form factor requirements in personal communication, computer and automotive markets have increased demand for KGD.
- Burn-in for KGD at wafer level requires less test insertions and reduces cycle time than die level burn-in. Similar cycle time reductions can also be realized for package devices by screening out early life failures before assembly.
- WLBI provides quicker feedback to wafer factory, which improves responsiveness to provide more effective process control.

Wafer Level Burn-in Methodology





Primary Attribute Differences*

Assume 360 die per wafer. Process 28 wafers or 10,080 devices per run.

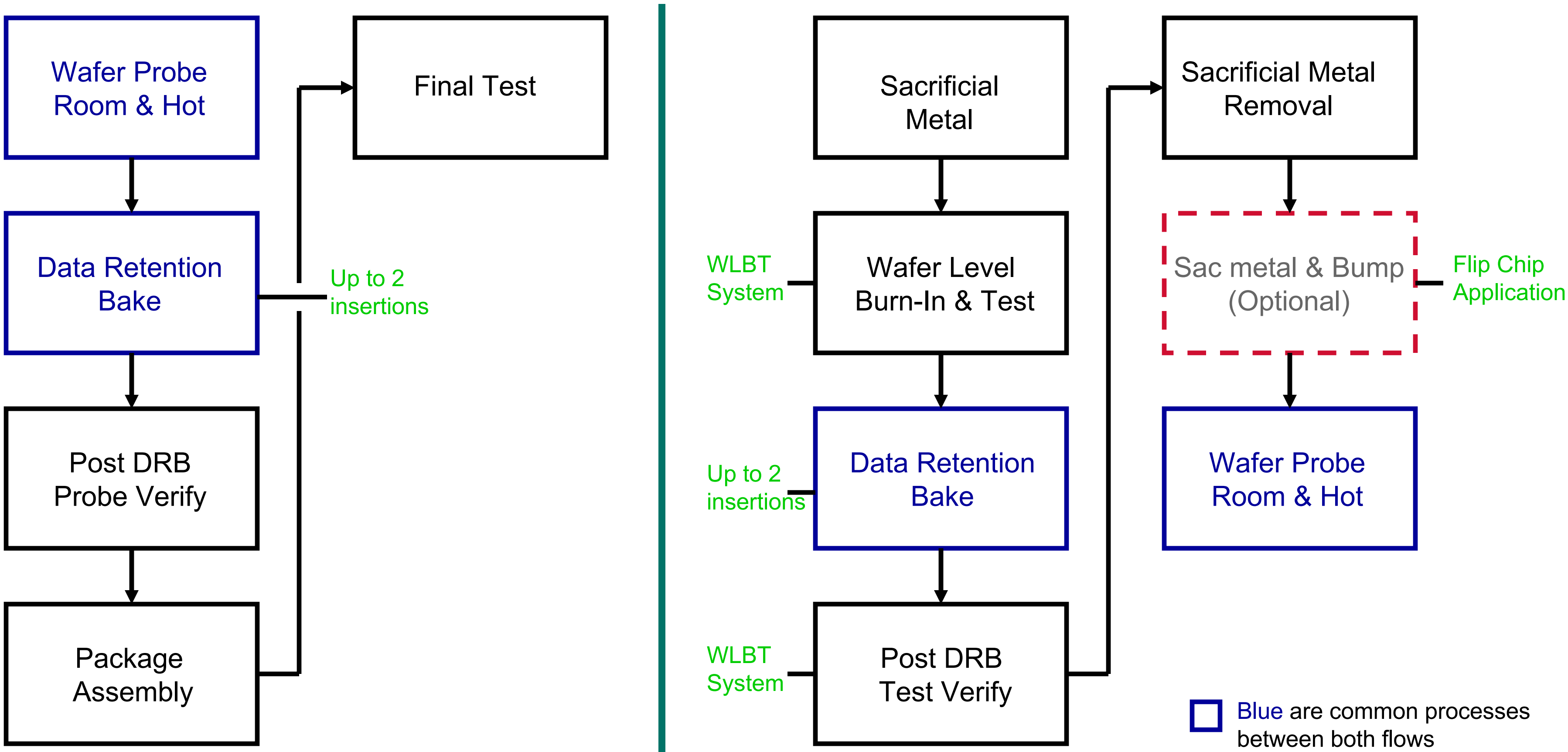
	SM WLBT	Pkg Burn-In and Test
# of Test Systems	1	7
# of Test Fixtures	28	360
Floor Area (sq ft)	90	210
System Thermal Dissipation	12 kW	21 kW

* **Information provided by Delta V Instruments**

Process Flow Differences

Standard test and assembly flow

Sacrificial Metal Wafer Level Burn-in/test and bump flow



Package Burn-In Cost Attributes

- **Wafer Probe**
  As charged by the factory – Mainly driven by test time
- **Data Retention Bake (optional)**
  As charged by the factory
- **Package and Assembly**
  Package type, Assembly, and Yield
- **Test**
  As charged by the factory – Mainly driven by test time
- **Burn-In**
  Burn-In Equipment and BI time
- **Post Burn-In Test**
  As charged by the factory – Mainly driven by test time

Package Cost Analysis Equations

In This exercise we normalize package cost to the wafer level to provide proper cost comparison between package vs. KGD cost for backend process

- ✓ Total Wafer Assembly Cost = WAC

  WAC = PAC * PDPW * WPY

  Where; WPY = Probe Yield, PDPW = Possible Good Die Per Wafer, PAC = Package Assembly Cost

- ✓ Total Wafer Package BI Cost = WPBIC

  WPBIC = PDPW * PAY * PBIC

  Where; PAY = Package Assembly Yield, PBIC = Package Burn-In Cost

- ✓ Total Wafer Final Test Cost (package test) = WFTC

  WFTC = PDPW * WPY * PAY * PFTC

  Where; PFTC = Package Final Test Cost

- ✓ Total Wafer Cost = TWC

  TWC = WPC * WAC * WPBIC * WFTC

  Where; WPC = Wafer Probe Cost

- ✓ Total Package Cost = TPC

  TPC = TWC / GPPW

  Where; GPPW = Good Package Per Wafer

SM WLBT Cost Attributes

- ✓**Sacrificial Metal Deposition and Pattern**
  - **Sputter, Photo, Etch, and Strip Process Equipment and Materials**
- ✓**Wafer Level Burn-In and Test**
  - **Test Equipment**
  - **Test Fixtures**
  - **Up to two insertions (DRB "1"s and "0"s)**
- ✓**Data Retention Bake (optional)**
- ✓**Sacrificial Metal Strip**
- ✓**Bump (optional)**
- ✓**Probe**
- ✓**Tape and Reel**

WLBT Analysis Equations

In This exercise we normalize KGD cost to the wafer level to provide proper cost comparison between package vs. KGD cost for backend process

- ✓ Good Die Per Wafer after WLBT = GDPW2

  GDPW2 = PDPW2 * WPY2

  Where; PDPW2 = Possible Good Die Per WLBT , WPY2 = WLBT Probe Yield

- ✓ Die Lost due to WLBT Implementation = DLWI

  DLWI = AGDPW – PDPW2

  Where; AGDPW = Anticipated Good Die Per Wafer (past probe, no WLBT)

- ✓ WLBT Cost Adder = WCA

  WCA = DLWI * PSP

  Where; PSP = Package Sales Price

- ✓ Total Wafer Cost (WLBT) = TWC2

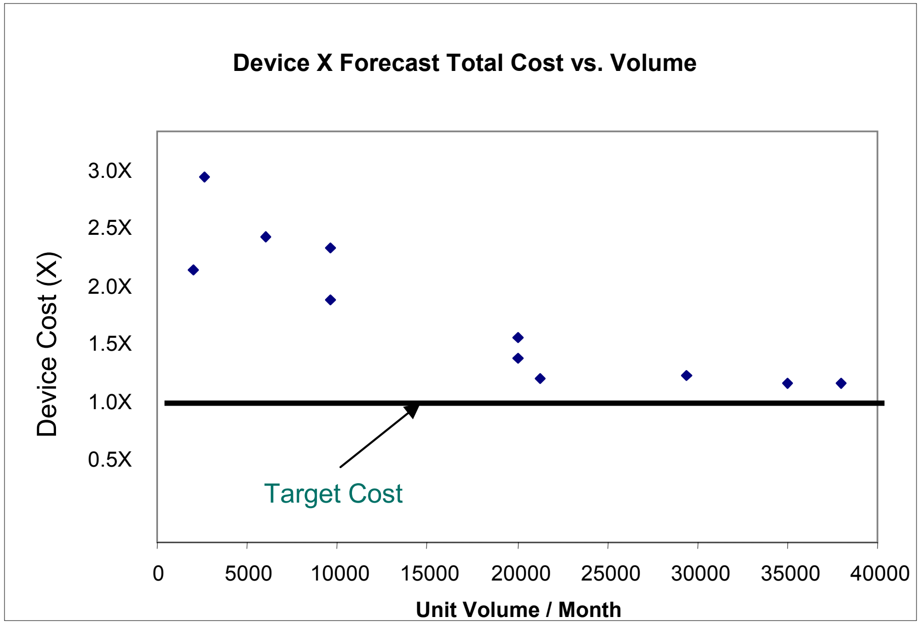
  TWC2 = WLBTC * WCA * WPC2

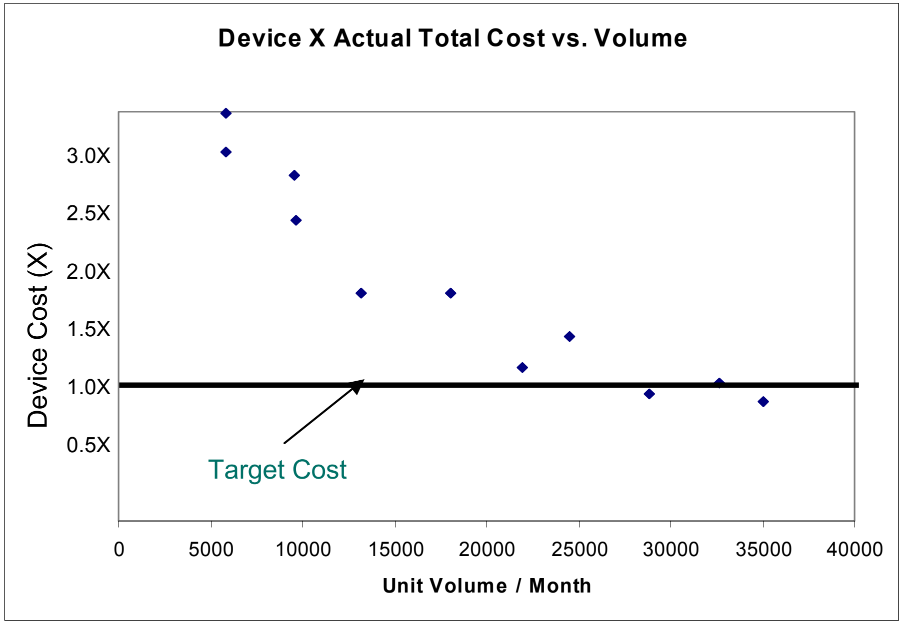
  Where; WLBTC = WLBT Cost (includes Sac. Metal and BIT), WPC2 = Wafer Probe Cost

- ✓ Known Good Die Cost = KGDC

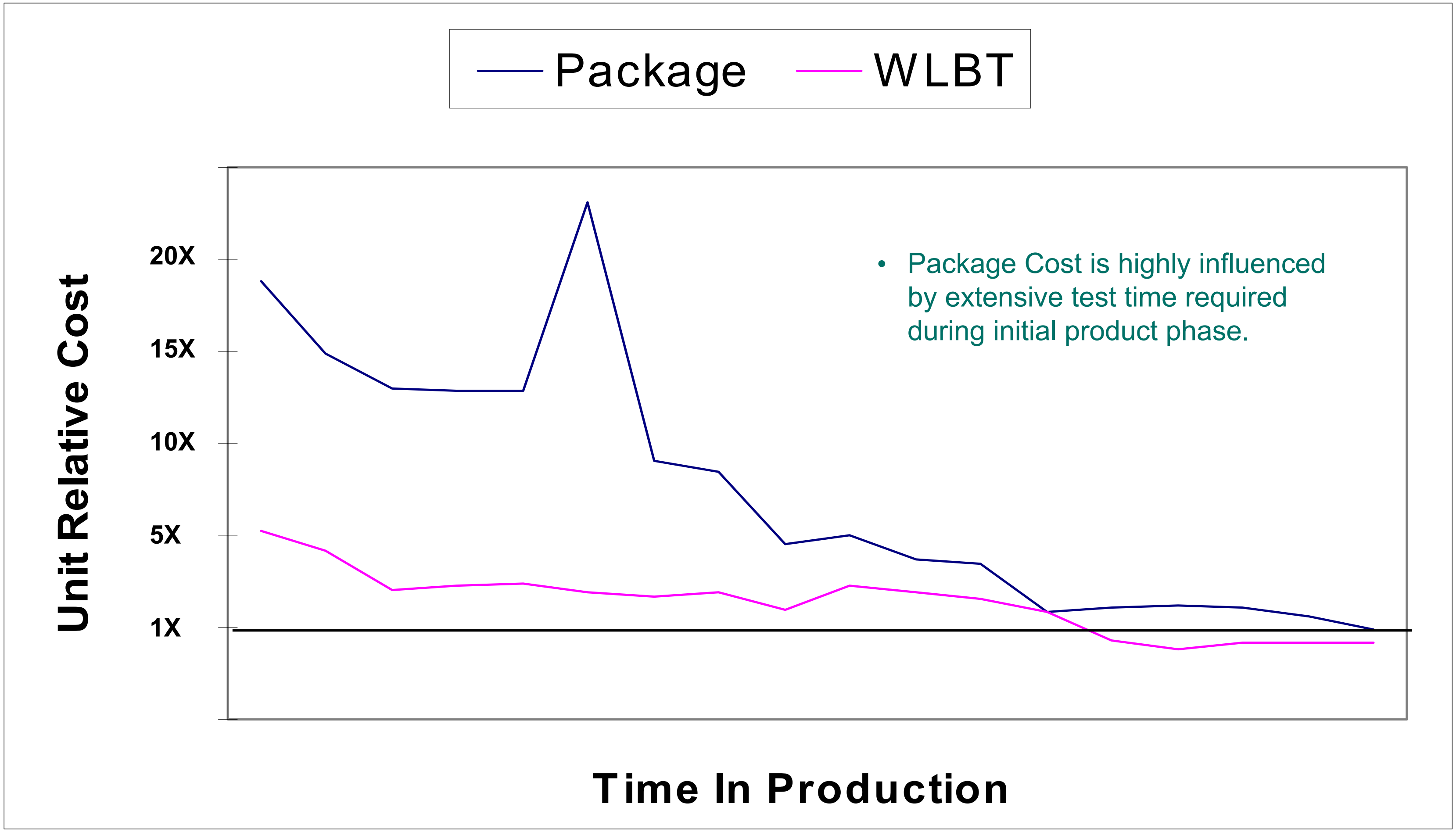
  KGDC = TWC2 / GDPW2

SM WLBT Forecast vs. Actual Cost





Total Unit Cost (Package vs. WLBT)



Summary
Sacrificial Metal Wafer Level Burn-in and Test

- **Sacrificial metal wafer level burn-in is a low cost test solution to achieving known good die.**
- **Motorola has been in production utilizing this technology since 1995.**
- **High cost test equipment and floor space requirement resulted in relative WLBT cost improvement as compared to package cost**

Acknowledgments

This speaker would like to acknowledge the teamwork from various Motorola SPS groups, Delta V Instruments, and Despatch Industries that contributed to the development and continuous improvement of this Sacrificial Metal Wafer Level Burn-in and Test program.

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